ECE/CS 5565 PROJECT3

Fall 2024

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PID: ddave

Q 1.1

Router	Interface	Link-Local Address	Global Unicast Address
Router1	eth0	fe80::a8bb:ccff:fe00:1/64	2001:db8:a:1::1/64
Router2	eth0	fe80::a8bb:ccff:fe00:2/64	2001:db8:a:2::1/64
Router3	eth0	fe80::a8bb:ccff:fe00:3/64	2001:db8:a:3::1/64
Router4	eth0	fe80::a8bb:ccff:fe00:4/64	2001:db8:a:4::1/64
Router5	eth0	fe80::a8bb:ccff:fe00:150/64	2001:db8:a:1::5/64
	eth1	fe80::a8bb:ccff:fe00:250/64	2001:db8:a:2::5/64
	eth2	fe80::a8bb:ccff:fe00:35/64	2001:db8:a:3::5/64
	eth3	fe80::a8bb:ccff:fe00:450/64	2001:db8:a:4::5/64

Q 1.2

We analyzed the Global Unicast Addresses (GUAs) for Router1 (eth0), Router2 (eth0), and Router5 (eth0 and eth1). Router1 (eth0) and Router5 (eth0) share the IPv6 prefix 2001:db8:a:1::/64 and the IPv4 subnet 192.168.1.x. Meanwhile, Router2 (eth0) and Router5 (eth1) share the IPv6 prefix 2001:db8:a:2::/64 and the IPv4 subnet 192.168.2.x. This means the connections between Router1 and Router5 are in a separate network from those between Router2 and Router5, with distinct subnets isolating traffic and ensuring efficient routing.

Q 1.3

Interval t = 0 to 1 s:

During this initial period, host1, host2, host3 and host4 send Neighbor Solicitation packets to their respective neigboring routers. The network is in the setup phase, and hosts begin to initialize their interfaces. The "NS" messages (Neighbor Solicitation messages) are part of the IPv6 Neighbor Discovery Protocol. Router1, Router2, Router3 and Router4 are the neigboring routers under the ICMPV6 protocol.

Purpose of NS Messages: These messages are used by hosts to determine the link-layer address of other nodes (e.g., routers) on the same local link or to verify that a neighbor is still reachable. This is crucial for establishing initial communication and populating the neighbor cache.

Q 1.4

Interval t = 2 to 5 s:

Host1, Host2, Host3 and Host4 send NS packets to the respective routers-Router1 to Router5 under ICMPV6 protocol. In this phase, the network transitions to establishing communication between hosts and routers. The "RS" (Router Solicitation) and "RA" (Router Advertisement) messages are exchanged.

Purpose of RS Messages: Sent by hosts to request configuration information from routers. Hosts use RS messages to prompt nearby routers to send RA messages.

Purpose of RA Messages: Sent by routers to provide network configuration information to hosts, such as prefixes, default routes, and other parameters necessary for IPv6 autoconfiguration.

Q 1.5

Interval t = 5 to 6 s:

During this time, routers begin to establish OSPFv3 neighbor relationships by exchanging "Hello" messages.

Purpose of OSPF Hello Messages: These messages are used to discover and maintain neighbor relationships. They help routers identify neighbors on the same network segment and establish the parameters for OSPF communication, such as hello intervals and dead intervals. If routers agree on the parameters, they can become OSPF neighbors and exchange routing information.

Q 1.6

Interval t = 15 to 16 s:

During this phase, routers exchange critical OSPF link-state information to maintain an accurate network topology. The process begins with routers sending OSPF Hello messages, followed by Database Description (DD) packets exchanged between Router1, Router2, Router3, Router4, and Router5 to synchronize their Link-State Databases (LSDBs).

After initial DD exchanges, Router5 compares its LSDB with those of the other routers. If discrepancies are detected, Router5 sends Link State Request (LSR) packets to request the missing or updated information. The neighboring routers respond with Link State Update (LSU) packets, containing the necessary updates. Once Router5 receives these updates, it sends Link State Acknowledgment (LSAck) packets to confirm receipt.

This sequence of DD, LSR, LSU, and LSAck messages ensures all routers maintain a consistent and up-to-date view of the network topology, which is crucial for efficient routing operations.

Q 1.7

The routers are updating each other by sending new OSPF Hello messages approximately every 10 seconds. This was determined by observing the simulation logs, where Hello messages were consistently sent at timestamps such as 5 s, 15 s and so on. The consistent 10-second interval between these messages indicates the configured OSPF Hello interval.

Q1.8

T=25s we could see the TCP connection established and we could see TCPseg packets exchanged between host 1 and host2 through the route given below.

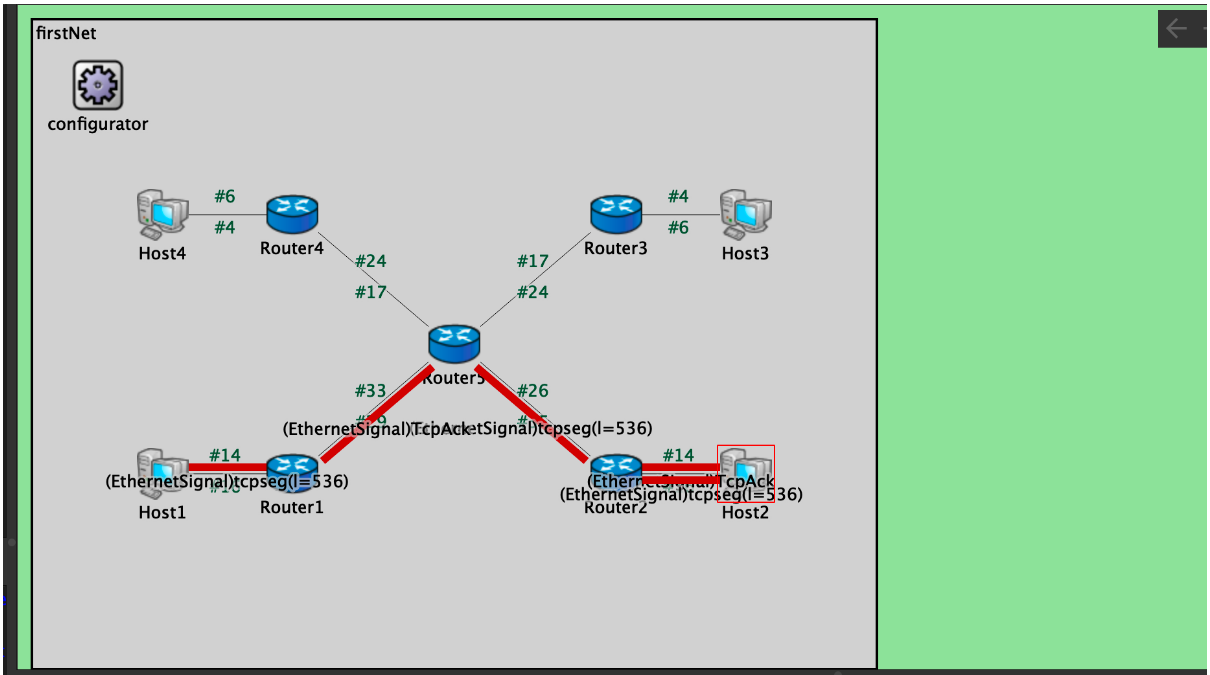
HOST1 <-> ROUTER1 <-> ROUTER5 <-> ROUTER2 <-> HOST2

This is further validated by examining the IPv6 routing table entries for Router1 and Router5 at the end of the simulation.

Router1: Destination 2001:db8:a:2::/64 with Next Hop fe80::a8bb:ccff:fe00:150 at 10.10.10.5/101

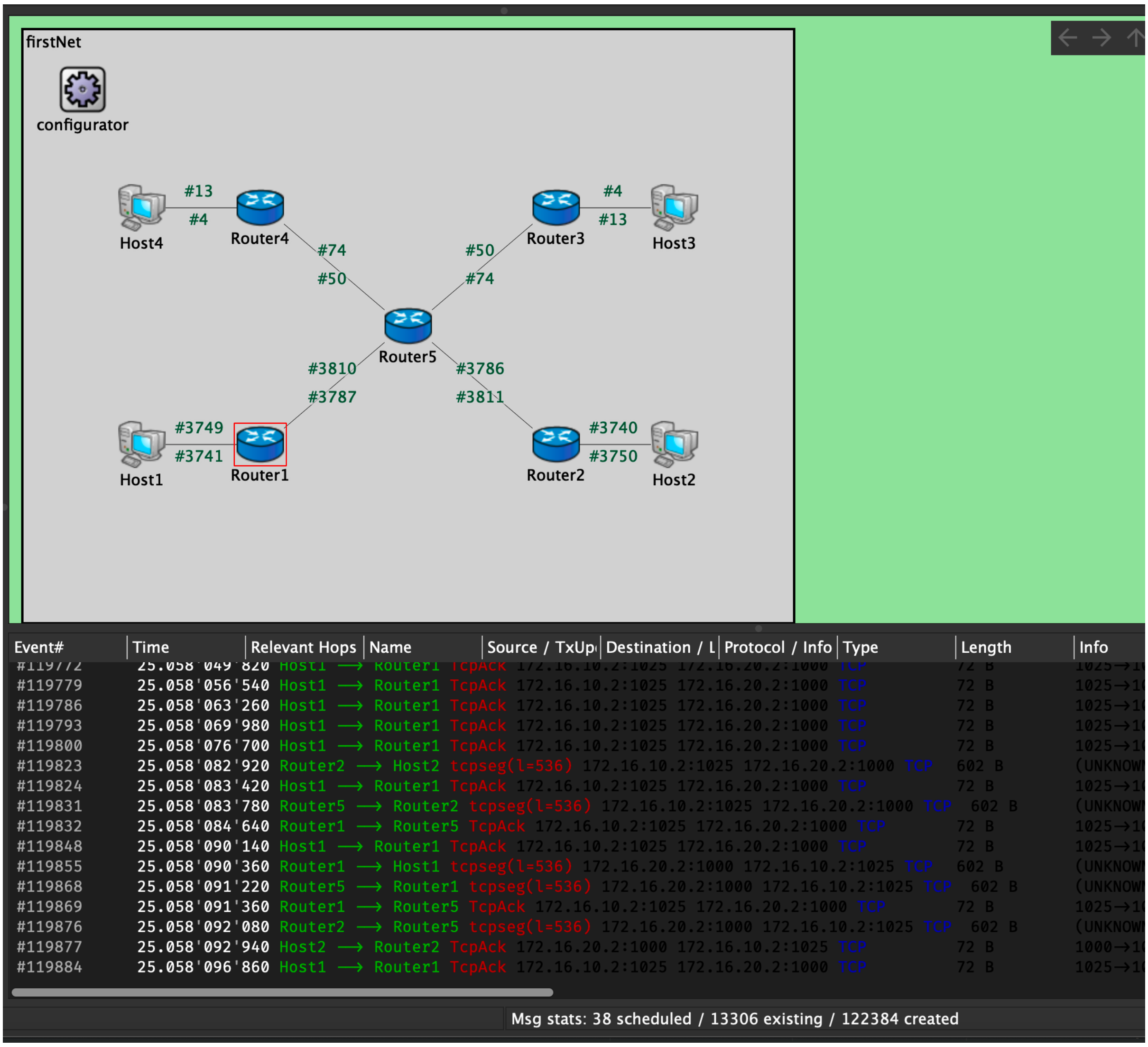
Router5: Destination 2001:db8:a:2::/64 with Next Hop fe80::a8bb:ccff:fe00:200 at 10.10.10.2/102

These destinations align with Router2's Global Unicast Address (GUA), and the Next Hops indicate the connections to Router5 (fe80::a8bb:ccff:fe00:150/10.10.10.5/101) and Router2 (fe80::a8bb:ccff:fe00:200/10.10.10.2/102), respectively.

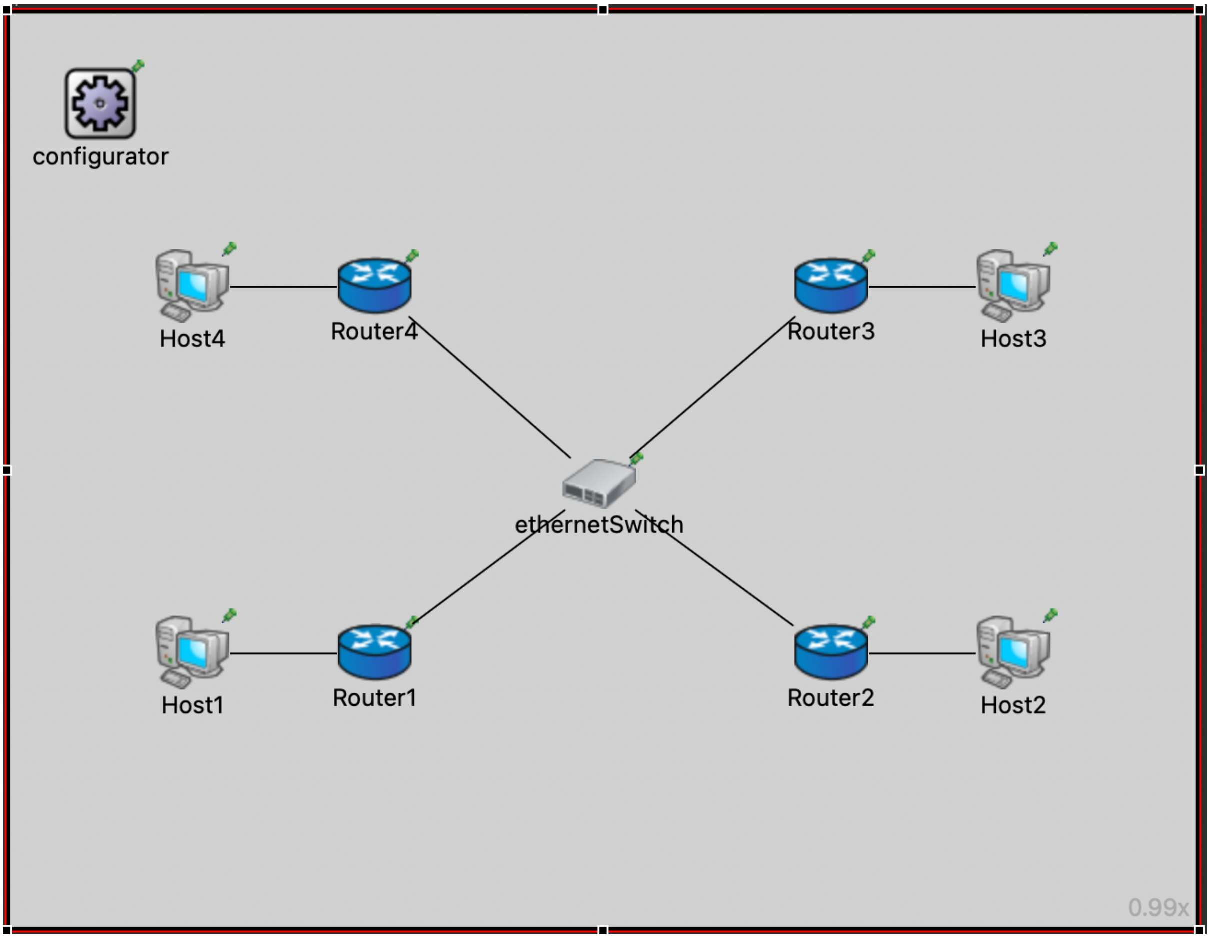


Event#	Time	Relevant Hops	Name	Source / TxUp	Destination / L	Protocol / Info	Type	Length	Inf
#2890	25.000'683'200	Router1 ⟶ Router5	tcpseg(l=536)	172.16.10.2:1025	172.16.20.2:1000	TCP		602 B	(U
#2891	25.000'684'060	Host1 ⟶ Router1	tcpseg(l=536)	172.16.10.2:1025	172.16.20.2:1000	TCP		602 B	(U
#2897	25.000'713'880	Router1 ⟶ Host1	tcpseg(l=536)	172.16.20.2:1000	172.16.10.2:1025	TCP		602 B	(U
#2904	25.000'714'740	Router5 ⟶ Router1	tcpseg(l=536)	172.16.20.2:1000	172.16.10.2:1025	TCP		602 B	(U
#2915	25.000'729'740	Host2 ⟶ Router2	TcpAck	172.16.20.2:1000	172.16.10.2:1025	TCP		72 B	10
#2922	25.000'730'600	Router2 ⟶ Host2	tcpseg(l=536)	172.16.10.2:1025	172.16.20.2:1000	TCP		602 B	(U
#2929	25.000'731'460	Router5 ⟶ Router2	tcpseg(l=536)	172.16.10.2:1025	172.16.20.2:1000	TCP		602 B	(U
#2936	25.000'732'320	Router1 ⟶ Router5	tcpseg(l=536)	172.16.10.2:1025	172.16.20.2:1000	TCP		602 B	(U
#2943	25.000'735'600	Router2 ⟶ Router5	TcpAck	172.16.20.2:1000	172.16.10.2:1025	TCP		72 B	10
#2960	25.000'762'140	Host1 ⟶ Router1	TcpAck	172.16.10.2:1025	172.16.20.2:1000	TCP		72 B	10
#2967	25.000'763	Router1 ⟶ Host1	tcpseg(l=536)	172.16.20.2:1000	172.16.10.2:1025	TCP		602 B	(U
#2968	25.000'763'860	Router5 ⟶ Router1	TcpAck	172.16.20.2:1000	172.16.10.2:1025	TCP		72 B	10
#2992	25.000'778'860	Host2 ⟶ Router2	TcpAck	172.16.20.2:1000	172.16.10.2:1025	TCP		72 B	10
#2999	25.000'779'720	Router2 ⟶ Host2	tcpseg(l=536)	172.16.10.2:1025	172.16.20.2:1000	TCP		602 B	(U
#3006	25.000'780'580	Router5 ⟶ Router2	tcpseg(l=536)	172.16.10.2:1025	172.16.20.2:1000	TCP		602 B	(U
#3007	25.000'781'440	Router1 ⟶ Router5	TcpAck	172.16.10.2:1025	172.16.20.2:1000	TCP		72 B	10

Q1.9


firstNet
configurator
Host4
Router4
#13
#4
Router3
Host3
#4
#13
#74
#50
#50
#74
Router5
#3810
#3787
#3786
#3811
Host1
Router1
#3749
#3741
Router2
Host2
#3740
#3750
Event# | Time | Relevant Hops | Name | Source / TxUp | Destination / L | Protocol / Info | Type | Length | Info
#119779 25.058'056'540 Host1 ⟶ Router1 TcpAck 172.16.10.2:1025 172.16.20.2:1000 TCP 72 B 1025→1
#119786 25.058'063'260 Host1 ⟶ Router1 TcpAck 172.16.10.2:1025 172.16.20.2:1000 TCP 72 B 1025→1
#119793 25.058'069'980 Host1 ⟶ Router1 TcpAck 172.16.10.2:1025 172.16.20.2:1000 TCP 72 B 1025→1
#119800 25.058'076'700 Host1 ⟶ Router1 TcpAck 172.16.10.2:1025 172.16.20.2:1000 TCP 72 B 1025→1
#119823 25.058'082'920 Router2 ⟶ Host2 tcpseg(l=536) 172.16.10.2:1025 172.16.20.2:1000 TCP 602 B (UNKNOW
#119824 25.058'083'420 Host1 ⟶ Router1 TcpAck 172.16.10.2:1025 172.16.20.2:1000 TCP 72 B 1025→1
#119831 25.058'083'780 Router5 ⟶ Router2 tcpseg(l=536) 172.16.10.2:1025 172.16.20.2:1000 TCP 602 B (UNKNOW
#119832 25.058'084'640 Router1 ⟶ Router5 TcpAck 172.16.10.2:1025 172.16.20.2:1000 TCP 72 B 1025→1
#119848 25.058'090'140 Host1 ⟶ Router1 TcpAck 172.16.10.2:1025 172.16.20.2:1000 TCP 72 B 1025→1
#119855 25.058'090'360 Router1 ⟶ Host1 tcpseg(l=536) 172.16.20.2:1000 172.16.10.2:1025 TCP 602 B (UNKNOW
#119868 25.058'091'220 Router5 ⟶ Router1 tcpseg(l=536) 172.16.20.2:1000 172.16.10.2:1025 TCP 602 B (UNKNOW
#119869 25.058'091'360 Router1 ⟶ Router5 TcpAck 172.16.10.2:1025 172.16.20.2:1000 TCP 72 B 1025→1
#119876 25.058'092'080 Router2 ⟶ Router5 tcpseg(l=536) 172.16.20.2:1000 172.16.10.2:1025 TCP 602 B (UNKNOW
#119877 25.058'092'940 Host2 ⟶ Router2 TcpAck 172.16.20.2:1000 172.16.10.2:1025 TCP 72 B 1000→1
#119884 25.058'096'860 Host1 ⟶ Router1 TcpAck 172.16.10.2:1025 172.16.20.2:1000 TCP 72 B 1025→1
Msg stats: 38 scheduled / 13306 existing / 122384 created

Q2.1



Q2.2

Router	Interface	Link-Local Address	Global Unicast Address
Router1	eth0	fe80::a8bb:ccff:fe00:100/64	2001:db8:a:1::1/64
Router2	eth0	fe80::a8bb:ccff:fe00:200/64	2001:db8:a:1::2/64
Router3	eth0	fe80::a8bb:ccff:fe00:300/64	2001:db8:a:1::3/64
Router4	eth0	fe80::a8bb:ccff:fe00:400/64	2001:db8:a:1::4/64

Q2.3

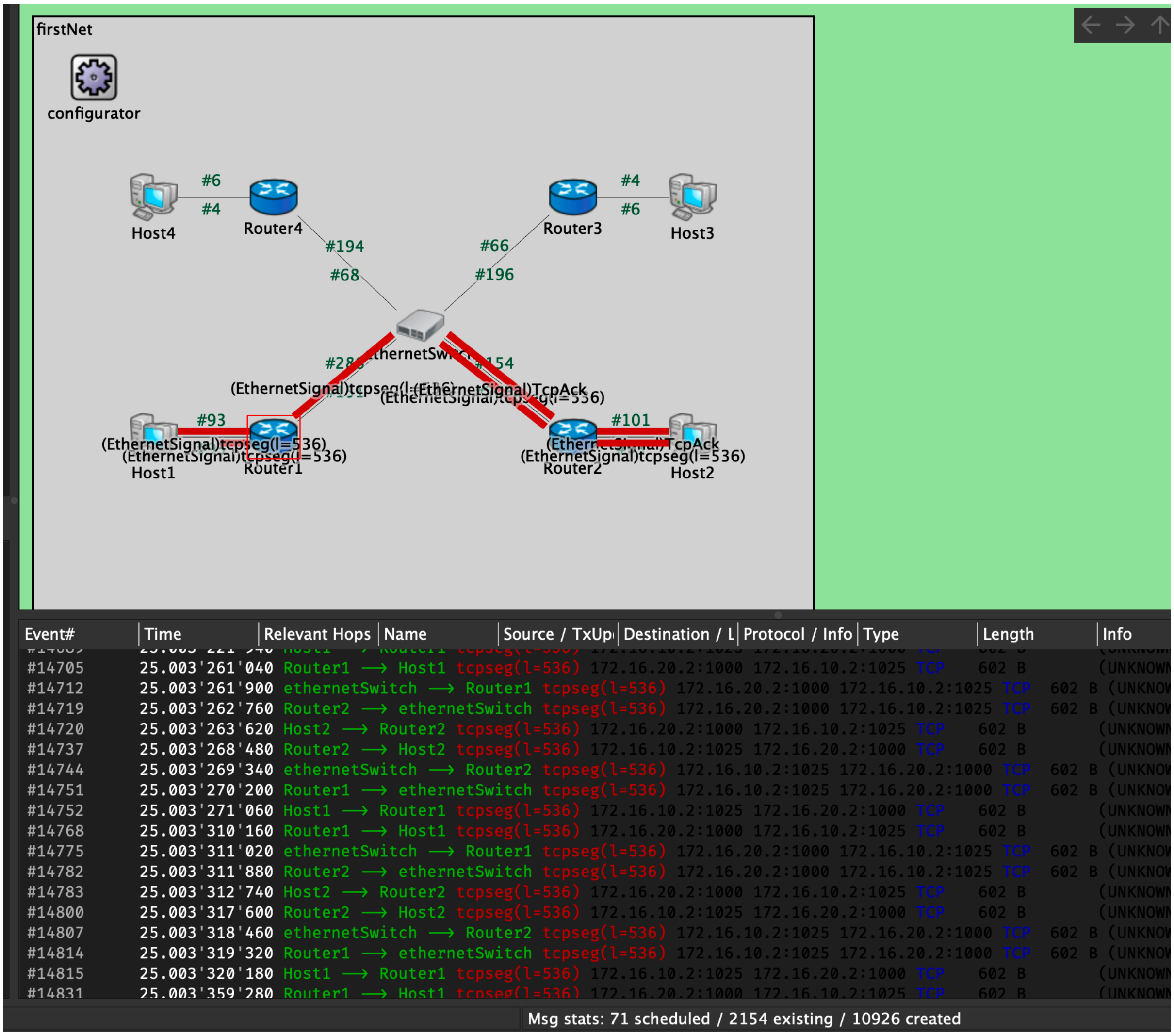
```
<Router id="Router1">
    <Routing6>
        <OSPFv3>
            <Process id="100">
                <RouterID>10.10.10.1</RouterID>
            </Process>
```

```
        </OSPFv3>
    </Routing6>

    <Interfaces>
        <Interface name="eth0">
            <Process id="100">
                <Instance AF="IPv6">
                    <InterfaceType>Broadcast</InterfaceType>
                    <Area>0.0.0.0</Area>
                </Instance>
            </Process>
<IPv6Address>fe80::a8bb:ccff:fe00:100/64</IPv6Address>
            <IPv6Address>2001:db8:a:1::1/64</IPv6Address>
        </Interface>
        <Interface name="eth1">
            <Process id="100">
                <Instance AF="IPv6">
                    <InterfaceType>Broadcast</InterfaceType>
                    <Area>0.0.0.0</Area>
                </Instance>
            </Process>
<IPv6Address>fe80::a8bb:ccff:fe00:110/64</IPv6Address>
            <IPv6Address>2001:db8:1::1/64</IPv6Address>
        </Interface>
    </Interfaces>
</Router>
```

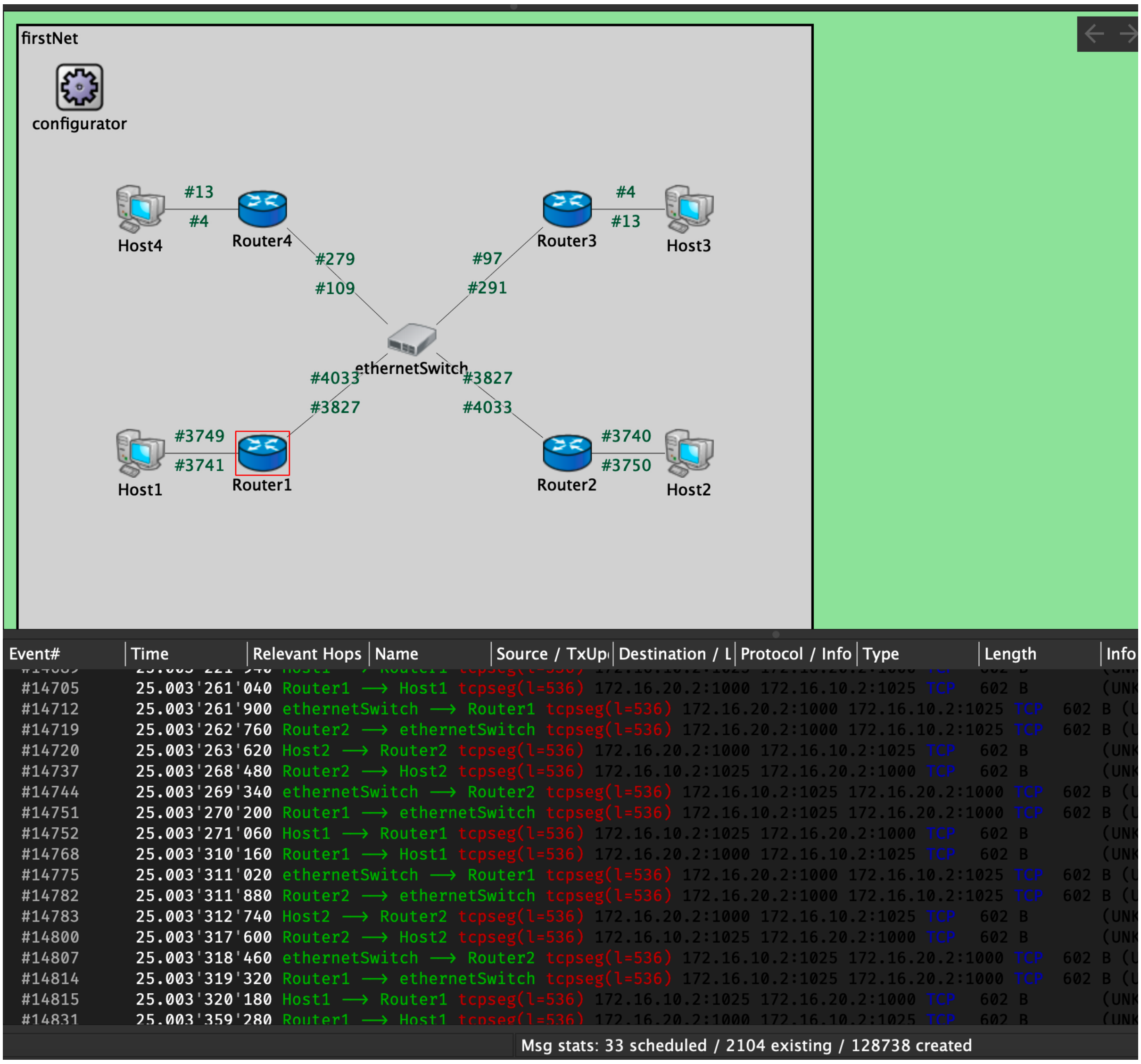
Q2.4

HOST1 <-> ROUTER1 <-> ETHERNETSWITCH <-> ROUTER2 <-> HOST2



T=25s we could see the TCP connection established and we could see TCPseg packets exchanged between host 1 and host2 through the route given below.

Q2.5


firstNet
configurator
Host4
Router4
Router3
Host3
ethernetSwitch
Host1
Router1
Router2
Host2
#13
#4
#279
#109
#97
#291
#4
#13
#4033
#3827
#3827
#4033
#3749
#3741
#3740
#3750
Event# | Time | Relevant Hops | Name | Source / TxUp | Destination / L | Protocol / Info | Type | Length | Info
#14705 25.003'261'040 Router1 ⟶ Host1 tcpseg(l=536) 172.16.20.2:1000 172.16.10.2:1025 TCP 602 B
#14712 25.003'261'900 ethernetSwitch ⟶ Router1 tcpseg(l=536) 172.16.20.2:1000 172.16.10.2:1025 TCP 602 B
#14719 25.003'262'760 Router2 ⟶ ethernetSwitch tcpseg(l=536) 172.16.20.2:1000 172.16.10.2:1025 TCP 602 B
#14720 25.003'263'620 Host2 ⟶ Router2 tcpseg(l=536) 172.16.20.2:1000 172.16.10.2:1025 TCP 602 B
#14737 25.003'268'480 Router2 ⟶ Host2 tcpseg(l=536) 172.16.10.2:1025 172.16.20.2:1000 TCP 602 B
#14744 25.003'269'340 ethernetSwitch ⟶ Router2 tcpseg(l=536) 172.16.10.2:1025 172.16.20.2:1000 TCP 602 B
#14751 25.003'270'200 Router1 ⟶ ethernetSwitch tcpseg(l=536) 172.16.10.2:1025 172.16.20.2:1000 TCP 602 B
#14752 25.003'271'060 Host1 ⟶ Router1 tcpseg(l=536) 172.16.10.2:1025 172.16.20.2:1000 TCP 602 B
#14768 25.003'310'160 Router1 ⟶ Host1 tcpseg(l=536) 172.16.20.2:1000 172.16.10.2:1025 TCP 602 B
#14775 25.003'311'020 ethernetSwitch ⟶ Router1 tcpseg(l=536) 172.16.20.2:1000 172.16.10.2:1025 TCP 602 B
#14782 25.003'311'880 Router2 ⟶ ethernetSwitch tcpseg(l=536) 172.16.20.2:1000 172.16.10.2:1025 TCP 602 B
#14783 25.003'312'740 Host2 ⟶ Router2 tcpseg(l=536) 172.16.20.2:1000 172.16.10.2:1025 TCP 602 B
#14800 25.003'317'600 Router2 ⟶ Host2 tcpseg(l=536) 172.16.10.2:1025 172.16.20.2:1000 TCP 602 B
#14807 25.003'318'460 ethernetSwitch ⟶ Router2 tcpseg(l=536) 172.16.10.2:1025 172.16.20.2:1000 TCP 602 B
#14814 25.003'319'320 Router1 ⟶ ethernetSwitch tcpseg(l=536) 172.16.10.2:1025 172.16.20.2:1000 TCP 602 B
#14815 25.003'320'180 Host1 ⟶ Router1 tcpseg(l=536) 172.16.10.2:1025 172.16.20.2:1000 TCP 602 B
#14831 25.003'359'280 Router1 ⟶ Host1 tcpseg(l=536) 172.16.20.2:1000 172.16.10.2:1025 TCP 602 B
Msg stats: 33 scheduled / 2104 existing / 128738 created

Q3.1

a)Message Type: Hello Packet (1)

b)(multicast/broadcast)

c)192.168.121.4

d)255.255.255.0

e)10s

f)2 active neighbours- Active Neighbor: 192.168.255.11, Active Neighbor: 192.168.255.15

Q3.2

a)Message Type: LS Update (4)

b)(unicast)

c)Advertising Router: 192.168.255.11

4. Summary:

No problems were encountered during the execution of this project